

The Impact of Chronological Age on Mandibular Movements

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الخلاصة

الأهداف: تهدف الدراسة الى تقييم القيم الطبيعية للحركات الفكّية في عيّنة تمثل مجموعة من الاعمار الزمنية المختلفة من سكان مدينة الموصل وتحليل الاختلافات طبقاً لمجموعات الأعمار الزمنية، إيجاد الارتباط بين قيم الحركات الفكّية وطول ووزن الجسم في كلّ مجموعة عمرية، وتحديد اختلافات الحركات الفكّية وفقاً للجنس في كلّ مجموعة عمرية. **المواد وطرائق العمل:** تم اختيار ثمان مئة وأربعون شخصاً للدراسة، تم تقسيمهم الى ست مجموعات طبقاً للعمر الزمني. المتغيرات التي حللت كانت إفتتاح الفم الأقصى، حركة الفك الجانبية اليمنى، حركة الفك الجانبية اليسرى، حركة الفك الأمامية؛ بإعتبار العمر، الطول، الوزن، والجنس. **النتائج:** أظهرت النتائج القيم القصوى للحركات الفكّية كانت في مجموعة الشباب. حيث كان هناك إرتباطات إيجابية معنوية بين قيم الحركات الفكّية، وكل من الطول والوزن. وُجدت إختلافات معنوية للحركات الفكّية بين الجنسين في كلّ المراحل العمرية، ماعدا مجموعة الأطفال. **الاستنتاجات:** تم قياس الحركات الفكّية لتكون قيم مرجعية للسكان العراقيين في مدينة الموصل. العمر، الطول، الوزن، والجنس متغيرات مهمة فيما يتعلق بقيم الحركات الفكّية.

ABSTRACT

Aims: The aims of this research are to evaluate mandibular movements' normal values in a representative population sample of various chronological ages, to analyze the differences according to the chronological ages groups, to find out the correlation between mandibular movements' values and height and weight in each age group, and to determine gender differences in each age group. **Materials and Methods:** A total of eight hundred forty subjects were chosen from primary and secondary schools and college of dentistry/Mosul University students and staff, in the city of Mosul in Iraq, and ordered into six groups according to the chronological age. The variables analyzed were maximum mouth opening MO, right and left lateral RL and LL, and protrusion movements P; considering age, height, weight, and gender. **Results:** Mandibular movements' ranges and means in normal healthy Iraqi population in the city of Mosul are: MO 35-70 mm 49.1 mm, RL and LL 4-13 mm 7.5 mm, P 3-13 mm 6.9 mm. The maximum mandibular movements' values were in young adults group. There were significant positive Pearson Correlations among mandibular movements' values, height, and weight. Significant differences $P < 0.5$ were found in terms of gender and mandibular movements in all age groups, except the children group. **Conclusion:** Mandibular movements' values were measured in order to establish normal reference values in Mosulian Iraqi population. Age, height, weight, and gender are important variables in relation to mandibular movements' values.

Keywords: Temporomandibular Joint, Mandibular Movements, Chronological Age

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INTRODUCTION

Temporomandibular Joint TMJ is a unique joint in which translatory as well as rotational movements are possible and where both the ends of bone articulate, in the same plane, with that of other bone, it is called as ginglymodiarthroidal type of joint, meaning that it has a relatively sliding type of movement between bony surfaces, in addition to hinge movement, common to diarthroidal joint.⁽¹⁾ The joint is considered an articulation between the base of the skull and the condyle of the mandible.⁽²⁾ The TMJ is comprised of three major components: the mandibular condyle, the mandibular fossa, and the

associated connective tissue, including the articular disk.⁽³⁾

Mandibular movement values are an important parameter within the clinical evaluation of the temporomandibular joint. Limited or increased movement is a sign of dysfunction.⁽⁴⁾ The position of widest mouth opening is associated with the condyle moving to the crest of the articular eminence or beyond, a wide variation in mandibular movement exist.⁽⁵⁾ The normal maximum mouth opening is $N \geq 40$ mm. Normal lateral and protrusive movements are $N \geq$ mm.⁽⁶⁾

Measures of the mandibular range of movement are similarly performed in chil-

dren. A study of 240 healthy Brazilian children aged 6-12 years, to determine the average range of mandibular movements, reported mean values: 44.51 mm for maximum mandibular opening; 7.71 mm for lateral excursion to the right; 7.92 mm for lateral excursion to the left; 7.45 mm for protrusive movements.⁽⁷⁾

Mandibular movements' values are influenced by numerous factors, including joint and muscle structure conditions, ethnicity, age, height, weight, and gender.⁽⁸⁻¹⁴⁾

Celic *et al*⁽¹¹⁾ found that muscle (extracapsular) and temporomandibular joint (intracapsular) disorders are often causes of limited mandibular movements. Landtwin⁽⁸⁾ stated that mandibular opening depends to a significant extent upon age and stature. Hirsch *et al*⁽¹²⁾ showed that normative values for jaw opening capacity were influenced by age and gender. Sousa *et al*⁽¹³⁾ found statistically significant correlations between the variables age, height, and weight, and all the evaluated mandibular movements range.

Mandibular movements' values were measured in order to establish normal reference values in Mosulian Iraqi population. Such values are an important indication of the function of the masticatory system and the temporomandibular joint. Factors which may influence mandibular movements values, such as age, height, weight, and gender must be taken into consideration.^(4,13) Nevertheless, no studies that evaluate such correlations in Mosulian Iraqi population were found.

Thus, the objectives of this research are to evaluate mandibular movements' normal values in a representative population sample of various chronological ages, to analyze the differences according to the chronological ages groups, to find out the correlation between mandibular movements' values and height and weight in each age group, and to determine gender differences in each age group.

MATERIALS AND METHODS

A total of eight hundred forty subjects were chosen from primary and secondary schools (Almajidat, Manarat AlMosul, Alqadisiya, Othman ibn Affan) and college

of dentistry/Mosul University students and staff, in the city of Mosul in Iraq, according to the following inclusion criteria:

No signs and symptoms of temporomandibular disorders.

No history of systemic diseases.

No more than four missing posterior teeth, all permanent incisors are present.

No history of facial trauma.^(4,7,13-15)

The sample was ordered according to the chronological age, the age groups being: Children ≤ 12 years, Adolescents 13-19 years, Young adults 20-29 years, Adults 30-39 years, Middle aged 40-60 years, and Old age group > 60 years.^(16,17)

The variables analyzed were maximum Mouth Opening MO, Right Lateral RL, Left Lateral LL, and Protrusion P movements; considering age, height, weight, and gender.

Mandibular movements: MO, RL, LL, P were measured using an electronic digital caliper IOS-USA, and following the Research Diagnostic Criteria for Temporomandibular Disorders RDC/TMD.⁽¹⁸⁾

MO: The vertical distance between the incisal edges of the maxillary and mandibular central incisors during maximum mouth opening, the extent of overbite was added and that of open bite was subtracted. RL and LL: The extent of the horizontal displacement of the mandibular midline from the maxillary midline during maximum dislocation of the mandible to the right and left respectively, with the mouth slightly opened in the physiologic rest position. P: The horizontal distance between the incisal edges of the maxillary and mandibular central incisors during maximum protruded position, with the mouth slightly opened in the physiologic rest position, the overjet was either added or subtracted accordingly.⁽¹⁸⁾

The data were computerized and statistically analyzed using the SPSS package 11.5 for Windows, the following tests were used: Descriptive statistic, ANOVA, Pearson Correlation Coefficient, *t*-test.

RESULTS

Descriptive statistic of mandibular movements range and mean in each age group was shown in Table (1).

Table (1): Descriptive statistic for age groups.

| Groups | MO | | RL | | LL | | P | |
|---------------------------|-------|-------------------|-------|------------------|-------|------------------|-------|------------------|
| | Range | Mean \pm SD | Range | Mean \pm SD | Range | Mean \pm SD | Range | Mean \pm SD |
| children (180) | 35-60 | 46.650 \pm 5.29 | 4-11 | 6.794 \pm 1.42 | 4-11 | 6.833 \pm 1.38 | 3-11 | 6.611 \pm 1.58 |
| adolescents (150) | 37-68 | 49.020 \pm 5.99 | 4-12 | 6.953 \pm 1.34 | 5-12 | 7.153 \pm 1.34 | 3-12 | 6.927 \pm 1.59 |
| young adults (150) | 37-70 | 51.933 \pm 5.88 | 6-13 | 8.407 \pm 1.40 | 6-13 | 8.293 \pm 1.17 | 5-13 | 7.900 \pm 1.42 |
| adults (130) | 37-68 | 51.123 \pm 6.05 | 5-13 | 8.239 \pm 2.23 | 5-11 | 7.831 \pm 1.32 | 4-12 | 7.645 \pm 1.82 |
| middle ages (130) | 37-64 | 49.600 \pm 5.30 | 5-11 | 7.800 \pm 1.19 | 5-10 | 7.615 \pm 1.27 | 4-12 | 6.831 \pm 1.39 |
| old ages (100) | 36-58 | 46.430 \pm 5.23 | 5-10 | 6.800 \pm 1.45 | 5-11 | 7.100 \pm 1.51 | 3-8 | 4.830 \pm 1.15 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement.

MO values range between 35-70 mm, RL and LL values range between 4-13 mm, P values range between 3-13 mm. Analysis of mean mandibular movements values according to the chronological age groups showed significant differ-

ences $p < 0.5$ among the groups, the maximum values were in young adults group, followed by adults, middle ages, adolescents, children, and the minimum values were in old ages group generally Table (2).

Table (2): Mandibular movements' mean values and standard deviations (mm) according to age groups.

| Age Groups | MO | RL | LL | P |
|---------------------------|--------------------|-------------------|-------------------|-------------------|
| children (180) | 46.650 \pm 5.29A | 6.794 \pm 1.42A | 6.833 \pm 1.38A | 6.611 \pm 1.58B |
| adolescents (150) | 49.020 \pm 5.99B | 6.953 \pm 1.34A | 7.135 \pm 1.34A | 6.927 \pm 1.59B |
| young adults (150) | 51.933 \pm 5.88C | 8.407 \pm 1.40C | 8.293 \pm 1.17C | 7.900 \pm 1.42C |
| adults (130) | 51.123 \pm 6.05C | 8.239 \pm 2.23C | 7.831 \pm 1.32B | 7.654 \pm 1.82C |
| middle ages (130) | 49.600 \pm 5.30B | 7.800 \pm 1.19B | 7.615 \pm 1.27B | 6.831 \pm 1.39B |
| old ages (100) | 46.430 \pm 5.23A | 6.800 \pm 1.45A | 7.100 \pm 1.51A | 4.830 \pm 1.15A |
| total (840) | 49.139 \pm 5.99 | 7.491 \pm 1.67 | 7.458 \pm 1.42 | 6.862 \pm 1.76 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement. Using ANOVA & Duncan.

Tables (3- 8) showed a significant positive Pearson Correlation among mandibular movements values, height, and weight. Significant differences $p < 0.5$ were found in terms of gender and mandibular

movements, which were greater among males in all age groups, except the children group, which exhibited no significant differences between gender Table (9).

Table (3): Relationships among mandibular movements' values, height and weight in children group.

| | MO | RL | LL | P | H | W |
|----|---------|---------|---------|---------|---------|---------|
| MO | 1 | 0.385** | 0.368** | 0.395** | 0.492** | 0.433** |
| RL | 0.385** | 1 | 0.757** | 0.556** | 0.374** | 0.273** |
| LL | 0.368** | 0.757** | 1 | 0.471** | 0.369** | 0.268** |
| P | 0.395** | 0.556** | 0.471** | 1 | 0.260** | 0.244** |
| H | 0.492** | 0.374** | 0.369** | 0.260** | 1 | 0.821** |
| W | 0.433** | 0.273** | 0.268** | 0.244** | 0.821** | 1 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement, H: height, W: weight. Using Pearson Correlation Coefficient. **Correlation is significant at the 0.01 level (2-tailed).

Table (4): Relationships among mandibular movements' values, height and weight in adolescents group.

| | MO | RL | LL | P | H | W |
|----|---------|---------|---------|---------|---------|---------|
| MO | 1 | 0.254** | 0.374** | 0.511** | 0.240** | 0.223** |
| RL | 0.254** | 1 | 0.742** | 0.311** | 0.207* | 0.208* |
| LL | 0.374** | 0.742** | 1 | 0.408** | 0.216** | 0.172* |
| P | 0.511** | 0.311** | 0.408** | 1 | 0.212** | 0.175* |
| H | 0.240** | 0.207* | 0.216** | 0.212** | 1 | 0.720** |
| W | 0.223** | 0.208* | 0.172* | 0.175* | 0.720** | 1 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement, H: height, W: weight. Using Pearson Correlation Coefficient. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table (5): Relationships among mandibular movements' values, height and weight in young adults group.

| | MO | RL | LL | P | H | W |
|----|---------|---------|---------|---------|---------|---------|
| MO | 1 | 0.286** | 0.288** | 0.255** | 0.500** | 0.323** |
| RL | 0.286** | 1 | 0.556** | 0.376** | 0.407** | 0.329** |
| LL | 0.288** | 0.556** | 1 | 0.349** | 0.374** | 0.170* |
| P | 0.255** | 0.376** | 0.349** | 1 | 0.249** | 0.173* |
| H | 0.500** | 0.407** | 0.374** | 0.249** | 1 | 0.732** |
| W | 0.323** | 0.329** | 0.170* | 0.173* | 0.732** | 1 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement, H: height, W: weight. Using Pearson Correlation Coefficient. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table (6): Relationships among mandibular movements' values, height and weight in adults group.

| | MO | RL | LL | P | H | W |
|-----------|-----------|-----------|-----------|----------|----------|----------|
| MO | 1 | 0.452** | 0.415** | 0.366** | 0.230** | 0.228** |
| RL | 0.452** | 1 | 0.603** | 0.458** | 0.283** | 0.359** |
| LL | 0.415** | 0.603** | 1 | 0.672** | 0.253** | 0.402** |
| P | 0.366** | 0.458** | 0.672** | 1 | 0.321** | 0.306** |
| H | 0.230** | 0.283** | 0.253** | 0.321** | 1 | 0.313** |
| W | 0.228** | 0.359** | 0.402** | 0.306** | 0.313** | 1 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement, H: height, W: weight. Using Pearson Correlation Coefficient. **Correlation is significant at the 0.01 level (2-tailed).

Table (7): Relationships among mandibular movements' values, height and weight in middle ages group.

| | MO | RL | LL | P | H | W |
|-----------|-----------|-----------|-----------|----------|----------|----------|
| MO | 1 | 0.472** | 0.426** | 0.512** | 0.239** | 0.197* |
| RL | 0.472** | 1 | 0.653** | 0.561** | 0.334** | 0.207* |
| LL | 0.426** | 0.653** | 1 | 0.536** | 0.295** | 0.244** |
| P | 0.512** | 0.561** | 0.536** | 1 | 0.277** | 0.217* |
| H | 0.239** | 0.334** | 0.295** | 0.277** | 1 | 0.783** |
| W | 0.197* | 0.207* | 0.244** | 0.217* | 0.783** | 1 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement, H: height, W: weight. Using Pearson Correlation Coefficient. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table (8): Relationships among mandibular movements' values, height and weight in old ages group.

| | MO | RL | LL | P | H | W |
|-----------|-----------|-----------|-----------|----------|----------|----------|
| MO | 1 | 0.778** | 0.847** | 0.610** | 0.376** | 0.370** |
| RL | 0.778** | 1 | 0.888** | 0.612** | 0.395** | 0.378** |
| LL | 0.847** | 0.888** | 1 | 0.653** | 0.365** | 0.334** |
| P | 0.610** | 0.612** | 0.653** | 1 | 0.256* | 0.219* |
| H | 0.376** | 0.395** | 0.365** | 0.256* | 1 | 0.767** |
| W | 0.370** | 0.378** | 0.334** | 0.219* | 0.767** | 1 |

MO: mouth opening, RL, LL: right and left lateral movements, P: protrusive movement, H: height, W: weight. Using Pearson Correlation Coefficient. **Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table (9): Comparison of mandibular movements' mean values and standard deviations (mm) between males and females in each age group.

| Groups | | MO | RL | LL | P |
|-----------------------|------------------------|-------------|------------|------------|------------|
| children (180) | male (90) mean±SD | 47.056±5.96 | 7.000±1.38 | 7.022±1.36 | 6.833±1.65 |
| | female (90) mean±SD | 46.244±4.52 | 6.589±1.44 | 6.644±1.38 | 6.389±1.48 |
| | p value | >0.5 | >0.5 | >0.5 | >0.5 |
| adolescents (150) | male (73) mean±SD | 51.507±6.23 | 7.370±1.47 | 7.562±1.44 | 7.589±1.61 |
| | female (77) mean±SD | 46.662±4.70 | 6.558±1.08 | 6.766±1.10 | 6.299±1.28 |
| | p value | <0.001 | <0.001 | <0.001 | <0.001 |
| young adults (150) | male (74) mean±SD | 55.568±5.07 | 8.838±1.50 | 8.568±1.23 | 8.230±1.37 |
| | female (76) mean±SD | 48.395±4.24 | 7.987±1.16 | 8.026±1.06 | 7.579±1.40 |
| | p value | <0.001 | <0.001 | <0.01 | <0.01 |
| adults (130) | male (63) mean±SD | 53.206±6.43 | 8.937±2.24 | 8.318±1.37 | 8.476±1.87 |
| | female (67) mean±SD | 49.164±4.98 | 7.582±2.02 | 7.373±1.11 | 6.881±1.38 |
| | p value | <0.001 | <0.001 | <0.001 | <0.001 |
| middle ages (130) | male (67) mean±SD | 50.746±5.20 | 8.090±1.24 | 7.940±1.19 | 7.194±1.35 |
| | female (63) mean±SD | 48.381±5.16 | 7.49±1.06 | 7.270±1.26 | 6.444±1.33 |
| | p value | =0.01 | <0.01 | <0.01 | <0.01 |
| old ages (100) | male (57) mean±SD | 47.877±5.48 | 7.175±1.62 | 7.509±1.53 | 5.088±1.04 |
| | female (43) mean±SD | 44.512±4.24 | 6.302±1.01 | 6.558±1.32 | 4.488±1.20 |
| | p value | =0.001 | =0.001 | =0.001 | <0.01 |

MO: mouth opening. RL, LL: right and left lateral movements. P: protrusive movement. Using *t*-test.

DISCUSSION

The determination of the means and standard deviations of the mandibular range of movement according to age and gender is justified by the need for parameters for the diagnosis of disorders involving the functionality of the stomatognathic system.⁽⁷⁾ The number of researches on mandibular movements' normal values across a broad age range is limited. Mandibular movements' ranges and means in normal healthy Iraqi population in the city of Mosul are: MO 35-70 mm 49.1 mm, RL and LL 4-13 mm 7.5 mm, P 3-13 mm 6.9 mm.

Mandibular movements' values increase with age from children to young adults, which may be attributed either to physiological maturation of the masticatory system due to central and peripheral changes or to functional adjustments due to changes in dentition and skeletal growth.⁽¹⁹⁾ This result agreed with other results,^(4,7,13) among these studies Machado *et al*⁽⁷⁾ and Sousa *et al*⁽¹³⁾ who evaluate mandibular movements range in Brazilian children aged 6-12 (n=240), and 6-14 (n=303) respectively, both reported an increase in

mandibular movements values with age.

On the other hand, the mandibular movements' values decrease with age from young adults to old ages, which may indicate that certain changes associated with increasing age in other synovial joints of the body also occur in the TMJ.⁽²⁰⁾ This result agreed with other results that stated a greater amplitude of mandibular movements' values in young adults.^(21, 22) Mezitis *et al*⁽²¹⁾ in a broad study to evaluate maximum mouth opening in 1160 Greek adults aged 18-70 years recorded a greatest mean mouth opening in younger ages 18-30 years, which tend to decrease with age, the same result was recorded by Gallagher *et al*⁽²²⁾ who evaluate the normal range of mandibular opening in an Irish population.

The positive relationships among mandibular movements' values, height, and weight suggest that, height and weight variables be considered when obtaining mandibular movements' values.⁽¹³⁾ Landtwing⁽⁸⁾ found a significant positive correlation between MO and stature in 1050 children and adolescents, Sousa *et al*⁽¹³⁾ also observed positive correlation between mandibular movements' values and height and weight in 303 children, Lawaf and Azizi⁽¹⁴⁾ found the same correlation between MO and height of 210 adults.

Mandibular movements' values were greater among males than females, this finding may be related to females' smaller stature,⁽⁸⁾ the same results were recorded with other authors^(15,21,22) in regarding to Saudi, Greek, and Irish population respectively.

In contrast to the previous result, no significant differences were found between mandibular movements' values in relation to children's gender. Hence, it is suggested that the influence that gender has on mandibular movements' values in adults is not observed in children, perhaps due to the fact that they do not have the sexual maturity of adults,⁽¹³⁾ several researches for evaluation of mandibular movements in Brazilian children aged 3-14 years reported no gender differences.^(7,13,23)

CONCLUSIONS

Normal mandibular movements' ranges and means values were measured to estab-

lish a normal range of mobility and to diagnose movements limitation in a Mosulian Iraqi population. Age, height, weight, and gender are important variables in relation to mandibular movements' values.

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